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Research Briefs

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Nutrition and Health

Getting more calcium might ease the stress for women around menstrual time, a 5-1/2 month study suggests. Ten women reported significantly fewer undesirable symptoms associated with the menstrual cycle when they got 1,300 milligrams of calcium rather than 600 mg. U.S. women average a little more than 600 mg in their daily diets. Women in the study experienced fewer PMS-type mood changes, such as irritability, anxiety, crying and depression, while on the higher calcium intake. They also reported fewer negative changes in behavior and concentration, such as ~~poorer work performance~~ and overall efficiency, avoiding social contacts, forgetfulness, confusion and accidents. And the extra calcium significantly reduced complaints of physical distress, such as headache, backache and cramps during menstruation.

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A "temper tester meter" hung near a honeybee hive, records how many times bees attempt to sting it. That's an indication of their demeanor, especially for Africanized bees that are crossing into Texas from Mexico. When provoked, Africanized bees sting often and in a swarm, while the European bees found in this country usually inflict only one

or a few stings. Once hostile hives have been located, they can be destroyed or the mean queen can be replaced with a gentle one who will produce friendlier offspring. ARS scientists continue to refine their patented electronic stingometer in Costa Rica, already invaded by Africanized bees, so it can be used as a way to protect people in this country.

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How does a change in diet affect the rate at which infants and adults synthesize cholesterol? The answer to that question is now possible with a harmless new test. Since the bulk of cholesterol circulating in people's blood—around 70 percent—is synthesized in the liver, the test will better define how different foods and other factors affect blood cholesterol levels. Ultimately, it will help researchers determine the ideal cholesterol intake from birth through childhood. U.S. children have higher cholesterol levels than those in other parts of the world, and their levels further increase starting in the late teens. Subjects merely drink some "heavy water," or deuterium oxide, and give several small blood samples. Researchers can calculate changes in the rate of cholesterol synthesis from changes in the deuterium content of cholesterol in red blood cells. The test has proved to be a sensitive measure of cholesterol synthesis in all ages. For example, cholesterol synthesis in five adult volunteers dropped by two-thirds within 1 to 4 days after they began eating five egg yolks daily. Early results with infants show that breast-fed infants synthesize far less cholesterol than formula-fed infants. This was expected because breast milk is very rich in cholesterol whereas infant formula contains none of the sterol.
Children's Nutrition Research Center, Houston, TX
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Older people, particularly older women, may need more vitamin B₆ than currently recommended. A recent 3-month study of men and women between 61 and 71 years old broadens the age range of data for setting future RDAs for vitamin B₆. These are now based on studies of younger adults. The 6 women in the study required 1.9 milligrams of B₆ compared to the current RDA of 1.6 mg. And the 6 men needed 1.96 mg. That's equal to the current 2-mg RDA, leaving no safety margin normally built into an RDA. It also appears that B₆ requirements for both sexes tend to equalize as people age. The findings help to explain why

older people repeatedly test more deficient in the vitamin than younger people. Marginal deficiencies don't produce clinical symptoms and can only be detected through biochemical tests. Since B₆ is important for the proper functioning of the nervous system, a persistently low intake could lead to depression, lethargy, confusion or nervousness. But these symptoms also could result from several other causes. Poultry, red meat, fish, fruits, vegetables and grain products all provide good amounts of vitamin B₆. The richest sources are fortified cereals, roasted breast of chicken and Cornish hen and braised beef liver.

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Adding more fiber-rich foods to your diet replaces the high-calorie foods you might otherwise eat. A new study shows it also slightly reduces absorption of the calories you do eat. The method used to calculate the number of calories people actually get from foods—known as metabolizable energy—was developed around the turn of the century, when eating habits were quite different. Because of the current emphasis on increasing dietary fiber and decreasing fat, researchers are checking the method's validity by direct measurement. In a 10-week study, 42 men alternated between eating a typical U.S. diet—with 34 grams of total fiber per day and 36 percent of calories from fat—and a diet with twice the fiber and half the fat. During the high-fiber period, about 4 percent more of the calories the men consumed passed through the gastrointestinal tract unabsorbed. Metabolizable energy from the high-fiber diet was 91.4 percent compared with 94.3 percent from the high-fat diet. Values in the USDA food tables (Handbook 8) overestimated the metabolizable energy of these diets by 5 and 8 percent, respectively.

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Breast-fed babies have a lower heart rate than formula-fed infants of the same age. They also spend less time in rapid-eye-movement (REM) sleep than their counterparts on formula, new studies show. These observations help explain why breast-fed infants burn fewer calories when they sleep. But they do not account for all the difference in basal metabolic rates between the two groups. The findings corroborate other reports that breast-fed infants differ physiologically from formula-fed infants, but the long-term significance of these differences is not known.

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A natural chemical in fungi specifically changes the process which controls the calcium content within cells, ARS researchers found. That chemical—cyclopiazonic acid (CPA)—could become a tool for understanding how calcium is regulated inside skeletal and cardiac muscle. As calcium moves into and out of muscle cells, its precise regulation within cells is critical for the muscle to function properly. Disruption of the regulation of calcium can cause some muscle diseases. CPA, a product of certain species of *Penicillium* and *Aspergillus* fungi, inhibits an enzyme responsible for calcium's regulation within muscle cells. CPA stops only calcium, so it is possible for new studies to zero in on whether the enzyme could be used to treat muscle diseases or in regulating the contraction and relaxation of skeletal and cardiac muscles. Such studies could lead to a model for a whole new class of medications designed to treat diseases involving a breakdown of calcium regulation in both humans and animals.

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A computer model called MALSIM (Malaria Simulation Model) predicts how many cases of malaria military officials can expect, given certain weather patterns and control measures. This debilitating and potentially deadly disease is a major concern for military troops stationed abroad. The new program has information about the life cycle of anopheline mosquitoes, including how temperature, moisture and other climatic factors affect their survival. MALSIM also "knows" that a mosquito must incubate malaria 12 to 14 days after biting an infected person before it can transmit the disease to someone else. MALSIM predicts the benefits of different control programs, including aerial spraying or troops' use of personal protection. Though the model hasn't been validated fully in a field situation, the military already is using it as a training tool. Computer simulations convince military leaders to provide protection for troops such as the mosquito killer permethrin for use on clothes and the repellent DEET on skin.

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Tomorrow's Foods and Fibers

Cherry tomatoes now being nurtured in test tubes could lead to high-tech indoor farming in the 21st century. Lab tomatoes raised by an ARS researcher have tiny "leaves" that aren't supposed to ripen like tomato fruit, but did. Unexpectedly, the calyx—the star-shaped, leaflike cluster at the top of the tomato where it joins the stem—turned red and juicy. Scientists now are working to uncover the genetic mechanism that triggered the unusual ripening. That might speed progress towards indoor farming in which growers could tend and harvest huge vats of billions of fruit and vegetable cells, such as tomato cells for paste, catsup, soup or salsa. This high-tech approach to food production would require less land, fertilizer and pesticide than traditional farming. But before fruit cells can be cultured for use in foods, scientists must find the ripening trigger and learn how to control it.

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Potatoes carrying genes borrowed from chicken eggs, moths or bacteria might better resist rots, bruise-related blackening, or herbicides. Eight different genes are being tested outdoors—most for the first time—in genetically engineered potatoes growing at test sites in Maine, Minnesota, North Dakota and Idaho. ARS researchers and their university colleagues inserted genes in five potato varieties: Atlantic, Katahdin, Russet Burbank (America's most widely planted potato) Lemhi Russet, and an experimental variety owned by Frito-Lay. A bacteria-fighting gene found in chickens is among those being tested in the potatoes. In chickens, this gene protects an embryo from infection until the chick develops its own immune system. The field tests could show whether the gene can help potatoes fend off destructive bacterial rots such as soft rot and ring rot. Antibacterial genes from the giant silk moth might similarly protect the high-tech potatoes; a gene from the greater wax moth might prevent ugly black spots from forming under the skin of tubers bruised at harvest.

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Small Grains and Potato Germplasm Research
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A new dyeing technique could offer consumers additional wrinkle-free garments while helping cotton textile and garment manufacturers cope with the changing fashion world. Currently, cotton fabric has to be dyed before a no-wrinkle finish is applied because the chemical bond created by the finishing process repels dyes. If the color goes out of fashion, however, the textile and garment

industries are stuck with a lot of dyed wrinkle-free inventory. So they often opt for unfinished fabric, giving consumers a limited selection of wrinkle-free cotton garments. Now, a variety of quaternary ammonia salts, some of which are found in chicken feed and fabric softener, solves the problem. Added to the no-wrinkle finish solution, the salts give the finished fabric a positive charge, which attracts dyes. ARS scientists found the technique also broadens the types of dyes that can be used on cotton and, in some cases, improves uptake of standard dyes, resulting in deeper hues.

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New stone-finishing techniques for cotton fabrics will make it easier for the textile industry to produce denim garments in a multitude of colors. Currently, color selection of a stone-washed or ice-washed garment is made before it becomes a garment, indeed, even before the fabric is woven. Blue and black are popular choices because they are more economical to produce on a large scale. The new stone-dyeing methods are based on ARS-patented processes that allow cotton to be dyed after a no-wrinkle finish is applied. This happens by injecting chemicals that either attract or repel dyes into porous volcanic rocks called pumice stones, which are used to make stone-washed and ice-washed garments. In one technique, a tumbler has stones soaked in chemicals that will ultimately make the areas touched by the stones acquire a positive charge. Then, these areas of the garment can be selectively dyed with dyes carrying a negative charge.

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Seed yield of pearl millet increased by up to 30 percent when scientists moved beehives close to the fields, so the bees could help pollinate the crop. Higher yields could make seed cheaper and help lesser developed countries like Sudan and India that rely on millet as a substantial source of protein. Along with grinding seed into flour, people overseas soak and boil millet seed as we do dry beans. Scientists are anxious to learn how well honey bees can boost seed production of other grasses.

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Food and Water Freshness and Safety

A tennis ball canister sparked an idea for a new trap that spells death for beetles hiding in stored products. It's designed to catch most of these pests that can infest packaged and bulk foods, such as flour, cereals, cornmeal, peanuts and grains stored in warehouses. An ARS scientist combined part of the concave bottom end of the canister with a portion of the top. Notches in the canister provide entrance ways for the pests, and a plastic lid contains a sex attractant to lure beetles into the trap. An inescapable pit was devised inside the canister, and the smooth surface was roughened so beetles will crawl towards a corn-based bait. When the pests try to reach the bait, they fall onto a sticky substance and are unable to escape.

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Bait minnows may serve as environmental sentinels for East Coast estuaries. ARS scientists are studying living mummichogs with magnetic resonance imaging to diagnose what they suspect is a water pollution-caused cancer at an early stage, much as similar machines are used in hospitals. The image shows pre-cancerous tissue damage. The mummichog is the first candidate in ARS' search for plants, animals or tissue that can be used as biosensors—living indicators of changes in water quality. ARS is interested in biosensors to ensure that fertilizers and pesticides are used safely. The mummichog can be netted from a brackish bay, tested with magnetic resonance imaging and returned unharmed. It came up for consideration as a biosensor when autopsies by Virginia Institute of Marine Science colleagues revealed a prevalence of liver tumors in mummichogs in an industrial discharge area of Virginia's Elizabeth River. Also, the fish are abundant along the entire East Coast and do not migrate. Therefore, local populations should reflect the health of their immediate environments.

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Natural compounds from spices and other sources may save millions of dollars worth of potatoes from premature sprouting. When potatoes sprout early, they soften and lose weight. Much of their starch turns to sugars that make french fries and potato chips turn an unattractive dark brown color when cooked. The natural sprouting inhibitors or slightly modified versions of them may become replacements for a synthetic inhibitor known as CIPC. ARS studies found the natural compounds can be applied to tubers to kill storage rot fungi and cause the tubers to live,

breathe and manufacture sugars at lower than normal rates. When the potatoes are prepared for serving, the compounds are washed away or destroyed by cooking, leaving no unusual flavors.

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Fragrances that mimic the aroma of night-blooming flowers might lure moths from corn and cotton fields before they mate and breed a new generation of destructive caterpillars. Floral lures mixed with an insecticide-laced bait would give tomorrow's growers and backyard gardeners a new, environmentally friendly tool for fighting *Helicoverpa zea* moths—a.k.a. as the corn earworm, tomato fruitworm and cotton bollworm. *H. zea* moths are vulnerable to this trickery: After changing from immature pupa to adult moths, they first seek tasty nectar, not a mate. ARS researchers have shown that the moths forage for nectar from night-blooming weeds and have identified a dozen key fragrance-imparting chemicals from the blossoms. Further tests will reveal the blend that yields the most potent lure.

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To male codling moths seeking a sexual rendezvous, females seem everywhere—but are rarely found. That's what happens when a phony sex scent wafted throughout the apple orchard, frustrating the male's search. No mating means no moth eggs and no worms in apples. Such mating disruption reduces the reliance on pesticides, employing instead thin plastic dispensers twisted onto tree branches. The 7-inch dispensers slowly release a fake version of the female moth's sex scent. ARS scientists fine-tuned the ratio and amounts of the sex-scent chemicals effective in 1-acre test orchards. They got 85 to 90 percent control of codling moths. A 90 percent control level translates to worm damage in fewer than 1 percent of the apples—very close to what commercial growers achieve with pesticides. Recent approval of the dispenser by the Environmental Protection Agency opens the way to large-scale tests in commercial orchards.

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